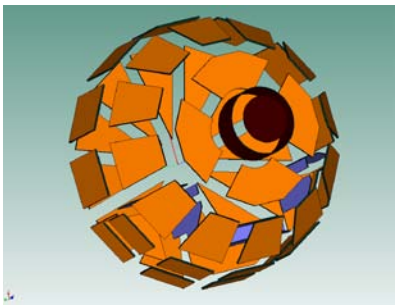
SPACECRAFT INTERNAL ACOUSTIC ENVIRONMENT MODELING

S. R. Chu,[1] and C. S. Allen[2]
[1]Lockheed Martin (1300 Hercules, M/C: C46 P.O. Box 58487, Houston, TX 77258, shao-sheng.r.chu@nasa.gov),
[2]NASA (Johnson Space Center, Mail Code SF22, 2101 NASA Road 1, Houston, TX 77058,
christopher.s.allen@nasa.gov)

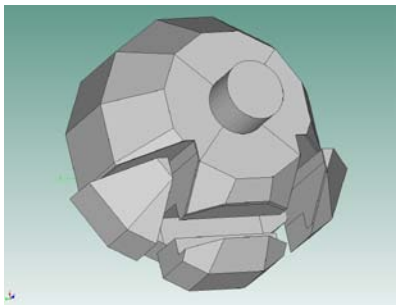
ABSTRACT
Acoustic modeling can be used to identify key noise sources, determine/analyze sub-allocated requirements, keep track of the accumulation of minor noise sources, and to predict vehicle noise levels at various stages in vehicle development, first with estimates of noise sources, later with experimental data. This paper describes the implementation of acoustic modeling for design purposes by incrementally increasing model fidelity and validating the accuracy of the model while predicting the noise of sources under various conditions. During FY'07, a simple-geometry Statistical Energy Analysis (SEA) model was developed and validated using a physical mockup and acoustic measurements. A process for modeling the effects of absorptive wall treatments and the resulting reverberation environment were developed. During FY'08, a model with more complex and representative geometry of the Orion Crew Module (CM) interior was built, and noise predictions based on input noise sources were made. A corresponding physical mockup was also built. Measurements were made inside this mockup, and comparisons were made with the model and showed excellent agreement. During FY'09, the fidelity of the mockup and corresponding model were increased incrementally by including a simple ventilation system. The airborne noise contribution of the fans was measured using a sound intensity technique, since the sound power levels were not known beforehand. This is opposed to earlier studies where Reference Sound Sources (RSS) with known sound power level were used. Comparisons of the modeling result with the measurements in the mockup showed excellent results. During FY'10, the fidelity of the mockup and the model were further increased by including an ECLSS (Environmental Control and Life Support System) wall, associated closeout panels, and the gap between ECLSS wall and mockup wall. The effect of sealing the gap and adding sound absorptive treatment to ECLSS wall were also modeled and validated.

CM Acoustic Mockup Exterior

CM Acoustic Mockup Interior



Mockup Acoustic Model



Mockup Acoustic Model